

AD-A107 878

ARMY MOBILITY EQUIPMENT RESEARCH AND DEVELOPMENT COMM--ETC F/G 13/2  
REMOVAL OF HYDROCARBON TASTE AND ODOR FROM POTABLE WATER BY REP--ETC(U)  
AUG 81 E RADOSKI  
MERADCOM-2334

UNCLASSIFIED

NL

Vol 1  
AD  
A107878



END  
DATE  
FILMED  
1 82  
DTIC

ADA107878

DTIC FILE COPY



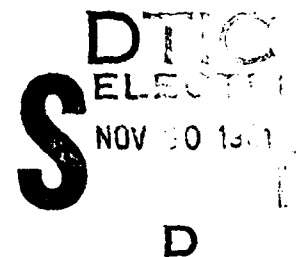
LEVEL

Report 2334

REMOVAL OF HYDROCARBON TASTE AND ODOR FROM  
POTABLE WATER BY REPLACEABLE  
CARBON-CONTAINING FILTER CARTRIDGES

by  
Elizabeth Radoski

August 1981



Approved for public release; distribution unlimited.

U.S. ARMY MOBILITY EQUIPMENT  
RESEARCH AND DEVELOPMENT COMMAND  
FORT BELVOIR, VIRGINIA

81 11 36

**Destroy this report when it is no longer needed.  
Do not return it to the originator.**

---

**The citation in this report of trade names of commercially available products does not constitute official endorsement or approval of the use of such products.**

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER 2334	2. GOVT ACCESSION NO. AD-A107 878	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) REMOVAL OF HYDROCARBON TASTE AND ODOR FROM POTABLE WATER BY REPLACEABLE CARBON-CONTAINING FILTER CARTRIDGES		5. TYPE OF REPORT & PERIOD COVERED Final Technical Report
7. AUTHOR(s) Elizabeth Radoski		6. PERFORMING ORG REPORT NUMBER
9. PERFORMING ORGANIZATION NAME AND ADDRESS Petroleum & Environmental Tech Div; Energy & Water Res Lab; U.S. Army Mobility Equipment Research and Development Command; Fort Belvoir, Virginia 22060		8. CONTRACT OR GRANT NUMBER(s)
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Mobility Equipment Research and Development Command; Fort Belvoir, Virginia 22060		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS Proj/Task: 1L162733AH20EW
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		12. REPORT DATE August 1981
		13. NUMBER OF PAGES 23
		15. SECURITY CLASS. (of this report) Unclassified
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited.		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Filter Potable Water Palatability Water Treatment Water Pollution		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report covers an investigation conducted to evaluate the effectiveness of replaceable carbon-containing filter cartridges for the removal of hydrocarbon taste and odor from potable water made non-drinkable by diesel fuel contamination. The results of the study indicate: carbon-containing filter cartridges effectively remove diesel fuel from potable water contaminated with the addition of 1 mg/l of fuel; POL tankers can be equipped with a simple housing containing replaceable carbon-containing filter cartridges for the conversion of cleaned POL tankers to potable water transport service.		

DD FORM 1 JAN 73 1473

EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

## PREFACE

The investigation covered by this report was an evaluation of the Filterite cartridge C40P-W2-U-ECIU, a carbon-containing filter, for the removal of the hydrocarbon taste and odor from potable water contaminated with diesel fuel. Work covered by this report was conducted under Project/Task 1L162733AH20-EW, "Water and Wastewater Management/Investigate Cartridge Filters."

The investigation was conducted by personnel of the Petroleum and Environmental Technology Division, Energy & Water Resources Laboratory, US Army Mobility Equipment Research and Development Command (MERADCOM), Fort Belvoir, Virginia. The investigation was directed by Mr. Maurice Pressman, Project Engineer. Mr. Peder B. Pedersen, Engineering Technician, set up the equipment. Mrs. Elizabeth Radoski, Chemist, conducted the tests.

Accession For	
NTIS GRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By _____	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A	

**DTIC**  
**ELECTE**  
S
D

NOV 30 1981

## CONTENTS

Section	Title	Page
	PREFACE	iii
	ILLUSTRATIONS	iv
I	INTRODUCTION	
	1. Objective	1
	2. Background	1
II	INVESTIGATION	
	3. Subject	2
	4. Equipment	2
	5. Procedure	2
III	RESULTS	
	6. Test Data	2
IV	DISCUSSION	
	7. Discussion	7
V	CONCLUSIONS	
	8. Conclusions	8
	APPENDIX DATA OF TESTING RESULTS	9

## ILLUSTRATIONS

Figure	Title	Page
1	Total System	3
2	500-Gal Plastic Tank	4
3.	30-Gal/min Electric Pump	5
4.	Filterite Corporation Open Filter Housing Containing Eight 40-in. Filter Cartridges	6
5.	Army 5000-Gal POL Tanker with Filter Separation	7

**THE REMOVAL OF HYDROCARBON TASTE AND ODOR  
FROM POTABLE WATER BY REPLACEABLE CARBON  
CONTAINING FILTER CARTRIDGES**

**I. INTRODUCTION**

**1. Objective.** The objective of this investigation was to determine the effectiveness of the Filterite Cartridge C40P-W2-U-ECIU, a replaceable carbon-containing filter, for the removal of hydrocarbon taste and odor from drinking water made undrinkable by diesel fuel contamination. Tests conducted were part of a test program evaluating POL tanker cleaning and water treatment procedures which would be required to convert POL tankers to potable water service in contingency operations.

**2. Background.** The investigation covered by this report was conducted as a followup to the study, entitled "Conversion of Army Fuel Tankers to Potable Water Service," conducted during the period July 1979 to August 1979 by Janet Hall, of the Petroleum and Environmental Technology Division, MERADCOM. The objective of the Hall investigation was to evaluate the adequacy of two cleaning methods for converting a 5000-gallon petroleum tanker to potable water service. The Hall investigation was a joint effort conducted by the US Army Quartermaster School, ATSM-CD-M and the Petroleum and Environmental Technology Division, Energy and Water Resources Laboratory, MERADCOM. The investigation was conducted as part of the TRADOC Concept Evaluation Program, No. TRMS9CEP011. Two M857 series tankers were obtained through USATARADCOM, Warren, Michigan. These two semitrailer tanks, 5000-gal capacity each (an M967, bulk haul model, and an M969, automotive fuel-dispensing model), had contained loads of diesel fuel and leaded mogas. The M967 bulk haul model semitrailer was cleaned with detergent (MIL-D-16791C Type 1) using TB ORD 1031 as guidance and steam cleaned in accordance with par. 52A(3) of TM5-700. The M969 (automotive refueler) model semitrailer was cleaned with a chemical solvent (25 gal of Product-Sol No. 913, an emulsified solvent/detergent mixture). Based on the data obtained during this investigation the following conclusions were drawn:

- a. Both cleaning procedures are acceptable for converting 5000-gal fuel tankers to potable water service.
- b. Even though chemical analysis indicated that the water stored in the tankers met the potable water standards of TB MED 229, the water acquired taste and odor which made it unpalatable.
- c. Water made unpalatable by traces of residual fuel can be made palatable by passing it through granular activated carbon.



The investigation covered in this report was conducted to evaluate the effectiveness of the Filterite cartridge C40P-W2-U-ECIU, a commercially available carbon-containing filter for the removal of the hydrocarbon taste and odor from potable water contaminated with diesel fuel.

## II. INVESTIGATION

**3. Subject.** During tests conducted in June 1979, it was demonstrated that even though POL tankers were vigorously cleaned by detergents or water-soluble petroleum solvents and thoroughly flushed with tap water, potable water stored in the tankers took on an objectionable hydrocarbon taste and odor which made the water unpalatable to a panel of tasters. Laboratory tests indicated that the taste and odor could be removed by passing the water through granular-activated carbon columns. The investigation covered by this report was conducted to assess the possibility of using filter cartridges containing carbon for the removal of taste and odor from fuel-contaminated water. The testing was done by Elizabeth Radoski during the period 25 Nov 80 to 5 Dec 80 at the Petroleum and Environmental Technology Division, Energy and Water Resources Laboratory, MERAD-COM (Figure 1). Samples were collected in styrofoam cups (Figures 1 and 4).

**4. Equipment.** The following items of test equipment were used:

- a. 500-gal plastic tank (Figure 2).
- b. 30-gal/min electric pump (Figure 3) manufactured by Gould, Inc.; Century Electronic Division; St. Louis, MO 63166.
- c. Filter housing containing eight 40-in. filter tubes (C40P-W2-U-ECIU) marketed by Filterite Corporation; Timonium, Maryland 21093 (Figure 4).

**5. Procedure.** The 500-gal tank was filled with tap water and contaminated with 1 mg/l of diesel fuel. The contaminated water was pumped through the filter housing equipped with the Filterite cartridges. The filter effluent was sampled at various intervals. The time of sampling, temperature of sample, and taste and odor observations were reported.

## III. RESULTS

**6. Test Data.** The results obtained in the investigation of evaluating the Filterite cartridge C40P-W2-U-ECIU for removal of hydrocarbon taste and odor from potable water contaminated with diesel fuel are given in the Appendix.



Figure 1. Total system.

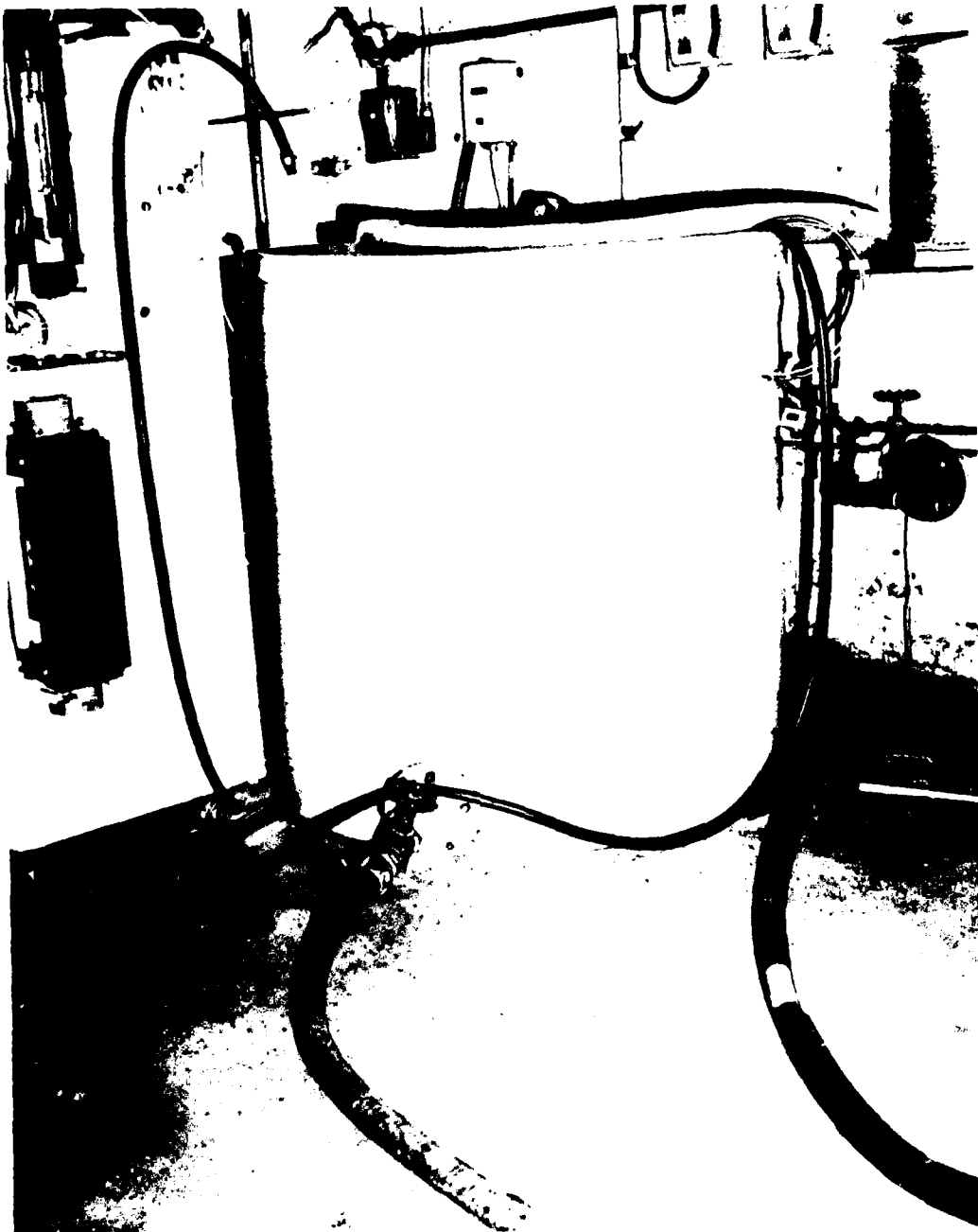


Figure 2. 500-Gal plastic tank.



Figure 3. 30-Gal/min electric pump.

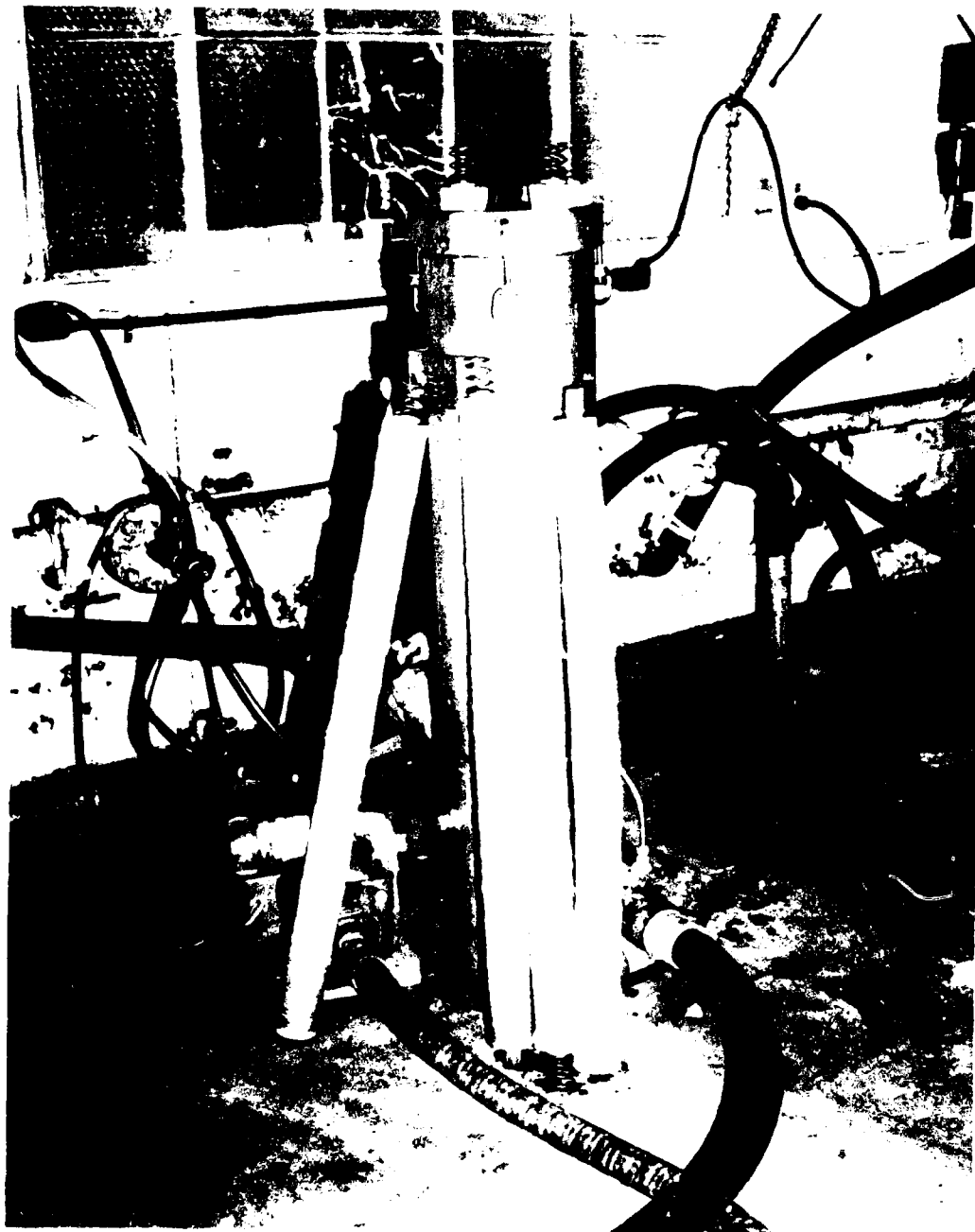


Figure 4. Filterite Corporation open filter housing containing eight 40-in. filter cartridges.

#### IV. DISCUSSION

7. **Discussion.** Twenty 500-gal tank volumes of potable water contaminated with 1 mg/l diesel fuel were run through the filter unit. The test water had a strong hydrocarbon taste and odor. The filtered water was free of any objectionable taste or odor. The volume of test water processed through the same filter cartridges is equivalent to two 5000-gal tanker loads of water. The filters were still working effectively after passage of 10,000 gal of water. Breakthrough was not established for the Filterite cartridges because of limitations on the available water for testing due to an area drought condition. Results indicated that the carbon-bearing cartridges were effective for the removal of taste and odor caused by the addition of 1 mg/l of diesel fuel to the potable water.

The Army's 5000-gal POL tanker is equipped with a filter separator (Figure 5) as part of its dispensing system. A detailed examination of the tanker by the Engineering Division of the Energy & Water Resources Laboratory indicated that this filter separator could easily be removed and replaced by a simple housing containing the filter cartridges which were tested. This filter cartridge assembly could serve as an effective polishing filter for the removal of objectionable taste and odor from water dispensed from cleaned POL tankers.

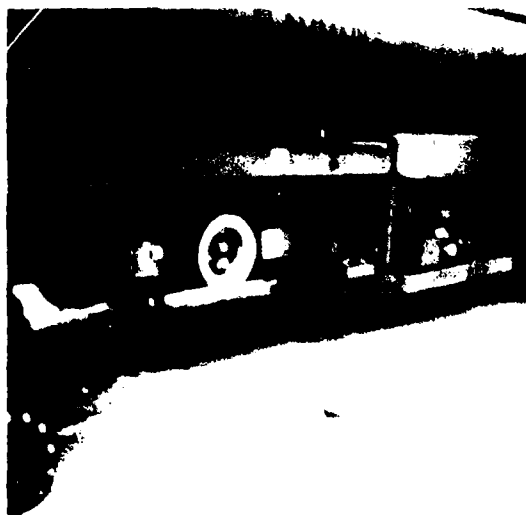


Figure 5. Army 5000-gal POL tanker with filter separation.

## V. CONCLUSIONS

### 8. Conclusions. It is concluded that:

- a. Carbon-bearing filter cartridges effectively removed diesel fuel from potable water contaminated with the addition of 1 mg/l of fuel.
- b. POL tankers can be equipped with a single housing containing carbon-bearing filter cartridges for the conversion of cleaned tankers to potable water transport service.

## **APPENDIX**

### **DATA OF TESTING RESULTS**

Initial observation of contaminated water:

- Oil film visible on surface of water
- Strong diesel fuel odor
- Tasted like gasoline—taste remained on tongue for the day.



SAMPLE TIME	TEMP	COMMENTS
Tank No. 1		
		Date: 25 Nov 80
5 min	18° C	Radoski "No odor/No taste"
13 min	18° C	Radoski "No odor/No taste"
15 min	18° C	Radoski "No odor/No taste"
Tank No. 2		
		Date: 26 Nov 80
5 min	18° C	Radoski "No odor/No taste"
13 min	18° C	Radoski "No odor/No taste"
15 min	18° C	Hasle "No odor"
Tank No. 3		
		Date: 26 Nov 80
5 min	16° C	Radoski "No odor/No taste"
10 min	16° C	Radoski "No odor/No taste"
15 min	16° C	Radoski "No odor/No taste"
Tank No. 4		
		Date: 26 Nov 80
5 min	14° C	Radoski "No odor/No taste"
10 min	14° C	Radoski "No odor/No taste"
15 min	14° C	Radoski "No odor/No taste"
Tank No. 5		
		Date: 2 Dec 80
5 min	19° C	Radoski "No odor/No taste"
10 min	19° C	Radoski "No odor/No taste"
15 min	19° C	Radoski "Potable Water"
Tank No. 6		
		Date: 2 Dec 80
5 min	14° C	Radoski "No taste/No odor"
10 min	14° C	Radoski "No taste/No odor"
15 min	14° C	Radoski "No taste/No odor"
Tank No. 7		
		Date: 2 Dec 80
5 min	16° C	Radoski "No taste/No odor"
10 min	16° C	Radoski "No taste/No odor"
15 min	16° C	Radoski "No taste/No odor"
Tank No. 8		
		Date: 2 Dec 80
5 min	14° C	Radoski "No taste/No odor"
10 min	14° C	Radoski "No taste/No odor"
15 min	14° C	Radoski "No taste/No odor"

SAMPLE TIME	TEMP	COMMENTS
Tank No. 9		Date: 3 Dec 80
5 min	16° C	Radoski "No taste/No odor"
10 min	16° C	Radoski "No taste/No odor"
15 min	16° C	Radoski "No taste/No odor"
Tank No. 10		Date: 3 Dec 80
5 min	14° C	Radoski "No taste/No odor"
10 min	14° C	Radoski "No taste/No odor"
15 min	14° C	Radoski "No taste/No odor"
Tank No. 11		Date: 3 Dec 80
5 min	16° C	Radoski "No taste/No odor"
10 min	16° C	Radoski "No taste/No odor"
15 min	16° C	Radoski "No taste/No odor"
Tank No. 12		Date: 3 Dec 80
5 min	16° C	Radoski "No taste/No odor"
10 min	16° C	Radoski "No taste/No odor"
15 min	16° C	Eskelund "No taste/No odor"
Tank No. 13		Date: 4 Dec 80
5 min	14° C	Radoski "No taste/No odor"
10 min	14° C	Radoski "No taste/No odor"
15 min	14° C	Radoski "No taste/No odor"
Tank No. 14		Date: 4 Dec 80
5 min	13° C	Radoski "No taste/No odor"
10 min	13° C	Radoski "No taste/No odor"
15 min	13° C	Davey "Drinkable"
Tank No. 15		Date: 4 Dec 80
5 min	13° C	Radoski "No taste/No odor"
10 min	13° C	Radoski "No taste/No odor"
15 min	13° C	Radoski "No taste/No odor"
Tank No. 16		Date: 4 Dec 80
5 min	14° C	Radoski "No taste/No odor"
10 min	14° C	Radoski "No taste/No odor"
15 min	14° C	Radoski "No taste/No odor"

SAMPLE TIME	TEMP	COMMENTS
Tank No. 17		
5 min	14° C	Date: 5 Dec 80
10 min	14° C	Radoski "No taste/No odor"
15 min	14° C	Radoski "No taste/No odor"
Tank No. 18		
5 min	13° C	Date: 5 Dec 80
10 min	13° C	Radoski "No taste/No odor"
15 min	13° C	Radoski "No taste/No odor"
Tank No. 19		
5 min	12° C	Date: 5 Dec 80
10 min	12° C	Radoski "No taste/No odor"
15 min	12° C	Radoski "No taste/No odor"
Tank No. 20		
5 min	12° C	Pressman "No taste/No odor"
10 min	12° C	Date: 5 Dec 80
15 min	12° C	Radoski "No taste/No odor"
		Radoski "No taste/No odor"
		Eskelund "Good Potable Water"

# DISTRIBUTION FOR MERADCOM REPORT 2334

No. Copies	Addressee	No. Copies	Addressee
	<b>Department of Defense</b>	1	Director US Army Materiel Systems Analysis Agency ATTN: DRXSY-CM Aberdeen Proving Ground, MD 21005
1	Director, Technical Information Defense Advanced Research Projects Agency 1400 Wilson Blvd Arlington, VA 22209		
12	Defense Technical Info Ctr Cameron Station Alexandria, VA 22314	1	Director US Army Materiel Systems Analysis Agency ATTN: DRXSY-MP Aberdeen Proving Grounds, MD 21005
	<b>Department of the Army</b>		
1	Commander, HQ TRADOC ATTN: ATEN-ME Fort Monroe, VA 23651	1	Director US Army Engineer Waterways Experiment Station ATTN: Chief, Library Branch Technical Info Ctr Vicksburg, MS 39180
1	HQDA (DAMA-AOA-M) Washington, DC 20310		
1	HQDA (DALO-TSM) Washington, DC 20310	1	Commander US Army Armament Research and Dev Command ATTN: DRDAR-TSS No. 59 Dover, NJ 07801
1	HQDA (DAEN-RDL) Washington, DC 20314		
1	HQDA (DAEN-MPE-T) Washington, DC 20314	1	Commander US Army Troop Support & Aviation Materiel Readiness Com ATTN: DRSTS-MES (1) 4300 Goodfellow Blvd St Louis, MO 63120
1	Commander US Army Material Readiness Cmd ATTN: DRCDE-E 5001 Eisenhower Ave Alexandria, VA 22333	2	Director Petrol & Fld Svc Dept US Army Quartermaster School Fort Lee, VA 23801
1	Technical Library Chemical Systems Lab Aberdeen Proving Ground, MD 21010	2	HQ, 193d Infantry Brigade (Pan) ATTN: AFZU-FE APO Miami 34004

No. Copies	Addressee	No. Copies	Addressee
2	Special Forces Detachment, Europe ATTN: PBO APO New York 09050	1	Commander and Director USA FESA ATTN: FESA-TS Fort Belvoir, VA 22060
2	Engineer Representative USA Research & Standardization Group (Europe) Box 65 FPO 09510	1	Director US Army TRADOC Systems Analysis Activity ATTN: ATAA-SL (Tech Lib) White Sands Missile Range, NM 88002
1	Commander Rock Island Arsenal ATTN: SARRI-LPL Rock Island, IL 61201	1	HQ, USAEUR & Seventh Army Deputy Chief of Staff, Engineer ATTN: AEAEEN-MT-P APO New York 09403
1	HQDA ODCSLOG DALO-TSE Room 1E588 Pentagon, Washington, DC 20310	1	HQ, USAEUR & Seventh Army Deputy Chief of Staff, Operations ATTN: AEAGC-FMD APO New York 09403
1	Plastics Technical Evaluation Ctr ARRADCOM, Bldg 3401 ATTN: A.M. Anzalone Dover, NJ 07801	1	<b>MERADCOM</b>  Commander, DRDME-Z Technical Director, DRDME-ZT Assoc Tech Dir/R&D, DRDME-ZN Assoc Tech Dir/Engrg & Acq. DRDME-ZE Spec Asst/Matl Asmt, DRDME-ZG Spec Asst/Ses & Tech, DRDME-ZK CIRCULATE
1	Commandant US Army Engineer School ATTN: ATZA-CDD Fort Belvoir, VA 22060	1	Chief, Ctrmine Lab, DRDME-N Chief, Engy & Wtr Res Lab, DRDME-G Chief, Elec Pwr Lab, DRDME-E Chief, Camo & Topo Lab, DRDME-R Chief, Mar & Br Lab, DRDME-M Chief, Mech & Constr Eqpt Lab, DRDME-H Chief, Ctr Intrus Lab, DRDME-X Chief, Matl Tech Lab, DRDME-V Dir, Product A&T Directorate, DRDME-T CIRCULATE
1	Commander Headquarters, 39th Engineer Battalion (Cbt) Fort Devens, MA 01433		
1	President US Army Armor and Engineer Board ATTN: ATZK-AE-PD-E Fort Knox, KY 40121		

No. Copies	Addressee
2	Engy & Wtr Res Lab, DRDME-G
30	Pet & Envir Tech Div, DRDME-GS
3	Tech Reports Ofc, DRDME-WP
3	Security Ofc (for liaison officers), DRDME-S
2	Tech Library, DRDME-WC
1	Programs & Anal Dir, DRDME-U
1	Pub Affairs Ofc, DRDME-I
1	Ofc of Chief Counsel, DRDME-L

**Department of the Navy**

1	Library (Code L08A) Civil Engineering Lab Naval Construction Battalion Ctr Port Hueneme, CA 93043
---	--

**Department of the Air Force**

1	Chief, Lubrication Br Fuels & Lubrication Div ATTN: AFWAL/POSL Wright-Patterson AFB, OH 45433
1	Department of Transportation Library, FOB 10A, M494-6 800 Independence Ave., SW Washington, DC 20591

**DATA  
FILM**